

April 4, 2018

Department of Motor Vehicles
Occupational Licensing Branch
2570 24th Street
Sacramento, CA 95818
ATTN: Elizabeth Humphreys, Mail Station H325

RE: GM Cruise LLC's Response to Request for Supplemental Information on Annual Autonomous Vehicle Disengagement Report.

Dear Ms. Humphreys,

I am responding to your letter requesting supplemental information on GM Cruise LLC's Annual Autonomous Vehicle Disengagement Report for the testing year ending on November 30, 2017, wherein you requested we provide further clarification of the description of facts causing the disengagements listed in the report. We appreciate the Department allowing additional time for us to provide the response. We recently relocated our headquarters. Your letter was delivered to our prior address and was not forwarded to us at our current address.

Cruise is one of the longest-standing participants in the California Autonomous Vehicle Tester Program, and we are proud to continue testing in our home state. Responsible deployment is one of our core values, and we live and breathe this every day. Safety is accounted for in all stages of our program - design, development, validation, and eventually, deployment. During those stages, we apply a comprehensive system safety approach that incorporates knowledge from engineering standards organizations, 100-plus years of experience from our GM resources, other industries such as aerospace, pharmaceutical and medical, and from the military and defense industries.

The vehicles we use in our on-road testing have a steering wheel, brake pedal, and accelerator pedal. Special operators (we call them "Autonomous Vehicle Trainers," or AVTs) monitor the vehicle at all times, and can take over immediately by tapping the brake or accelerator, moving the steering wheel, or pressing a button on the dash. The AVTs are trained and kept up to date on rules of the road, safe driving, how to monitor the vehicle, and when to take over. We encourage AVTs to take over "early and often," and our simulation capabilities allow us to look forward and see how the car would have performed absent a takeover. AVT passengers take notes regarding the vehicle's performance, and those notes provide additional guidance (in addition to logged system data) for our engineering teams to continue improving our software. As noted above, safety underlies all our testing, and it's the driver of our improvements.

Please find attached GM Cruise LLC's Supplement to the Annual Report of AV Mode Disengagements, providing the definitions of the categories of precautionary takeovers that are listed in the report, as well as examples of the causes of such disengagements.

Sincerely,



Albert Boniske

Director of Product Integrity

Supplement to the Annual Report of AV Mode Disengagements

Testing Period Covered: December 1, 2016 to November 30, 2017

The disengagements described below are part of the development of key technologies in our AV's automated driving system. Further description of those technologies can be found in our **2018 Self-Driving Safety Report**, available at www.gm.com.

Causal factors:

Precautionary takeover to address perception:

These events support development of our perception system—the system in the vehicle that detects and classifies the three dimensional space around the vehicle. They identify situations in which we focus improvement in our AV's ability to perceive (and not misperceive) objects around the vehicle.

Examples include:

- The sensors not holistically capturing all data on vehicles approaching in opposite lanes; and
- The AV not combining all data regarding another vehicle entering into an intersection.

Precautionary takeover to address planning:

These events support the development of our AV's planning system—the system that plans routes to navigate the vehicle through its environment, using information from the perception system and other vehicle systems. Disengagements in this category refer to events in which the AV perceived the objects around it, but dynamic circumstances develop and takeovers were necessary to support further development in the AV's path planning abilities.

Examples include:

- The AV planning to make a turn into a lane of traffic for which there was insufficient space for the lane change;
- The AV not planning to offer an entrance space to another vehicle pulling into the AV's path; and
- The AV planning to make a turn with oncoming traffic approaching quickly.

Precautionary takeover to address controls:

These events support the development of our controls system—the system that turns the routes and decisions from the planning system into commands sent through the vehicle's networks to the vehicle's actuators. Disengagements in this category refer to events in which the AV perceived objects around it and the planned path was acceptable, but the message to the mechanical controls of the AV warranted improvement.

Examples include:

- The AV not braking strongly enough when approaching a stop; and
- The AV executing a right turn too widely.

Precautionary takeover to address construction behavior:

These events support development of our perception, planning, and controls systems—in the specialized area of driving in construction zones. Disengagements in this category refer to takeovers necessary to support further development of the AV's ability to perceive elements of construction zones, to create plans through the new road environment the construction created, and to manage mechanical execution over what are often unusual surfaces.

Examples include:

- The AV having difficulty maneuvering around construction cones; and
- The AV attempting to change lanes around construction cones.

Other road users behaving poorly:

These events support the development of reactive elements of our safety functionality—particularly the ability of our AV to react to the unsafe behavior of other road users. Our vehicle has various features to react to the unexpected—from backup paths in the planning system to a crash-imminent braking system. Disengagements in this category refer to takeovers necessary to support further development of the vehicle's ability to respond to other road users behaving in an unsafe manner.

Examples include:

- Other vehicles not yielding to the AV;
- Other vehicles running stop signs;
- Other vehicles drifting into the AV's lane; and
- Other vehicles aggressively cutting in front of the AV.